White oak group

White oak, *Quercus alba*
Bur oak, Quercus macrocarpa
Swamp white oak, Quercus bicolor

The volume of white oak has increased significantly over the last 50 years due mainly to an increase in the number of large trees. Models predict an increase of 14% in the next 40 years but white oak volume is predicted to peak in 2039.

Rates of growth and mortality have increased but mortality is still lower than average for all species. Whereas white oaks make up about 4.8% of volume and 3.2% of growth in Wisconsin, this species group accounts for only 2.3% of mortality.

White oak is **an important timber species**, accounting for 3% of growing stock removals from 2010 to 2015. The density of white oak wood is very high which makes it a valuable species for biomass production.

- *How has the white oak resource changed?*
  Volume and diameter class distribution:
- *Where is white oak found in Wisconsin?*
  Growing stock volume by region with map
- *What kind of sites does white oak grow on?*
  Habitat type and site index distribution
- *How fast is white oak growing?*
  Average annual net growth: trends and ratio of growth to volume
- *How healthy is white oak in Wisconsin?*
  Average annual mortality: trends and ratio of mortality to volume
- *How much white oak do we harvest?*
  Roundwood production by product and ratio of growth to removals
- *How much white oak biomass do we have?*
  Tons of aboveground biomass by region of the state
- *Can we predict the future of white oak?*
  Modelling future volumes

Division of Forestry
WI Dept of Natural Resources 2016

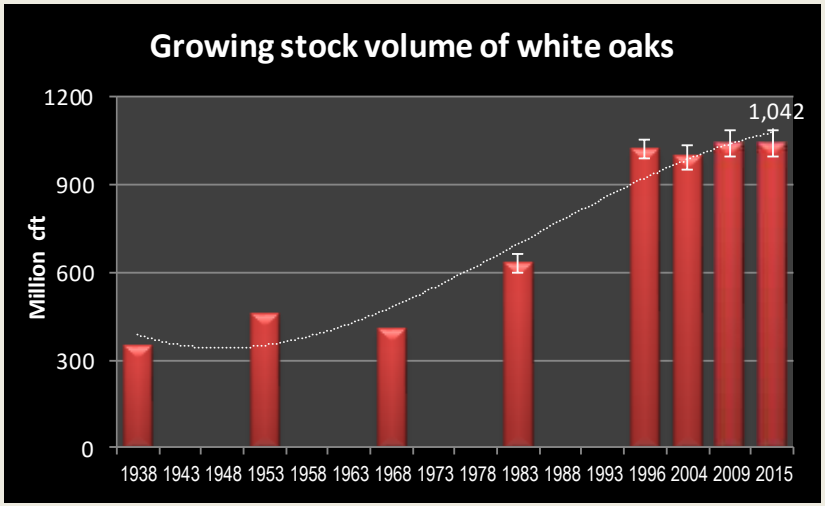
"How has the white oak resource changed?"

Growing stock volume and diameter class distribution by year

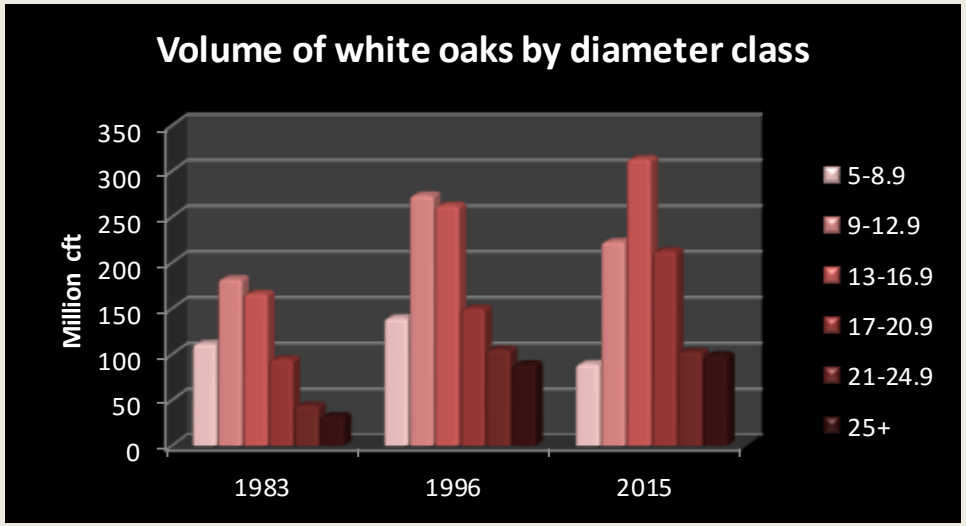
The growing stock volume of white oaks is approximately 1.0 billion cubic feet or about 4.8% of total statewide volume (chart on right). Volume rose steadily from 1938 to 1996 but has remained statistically unchanged since 1996.

Growing stock volume in all size classes has increased since 1983 but especially in larger trees (chart below left). The volume in small trees (5 to 12.9 inches) has decreased 24% since 1996 while volume in large trees (13+ inches) has increased by 20% in the same period.

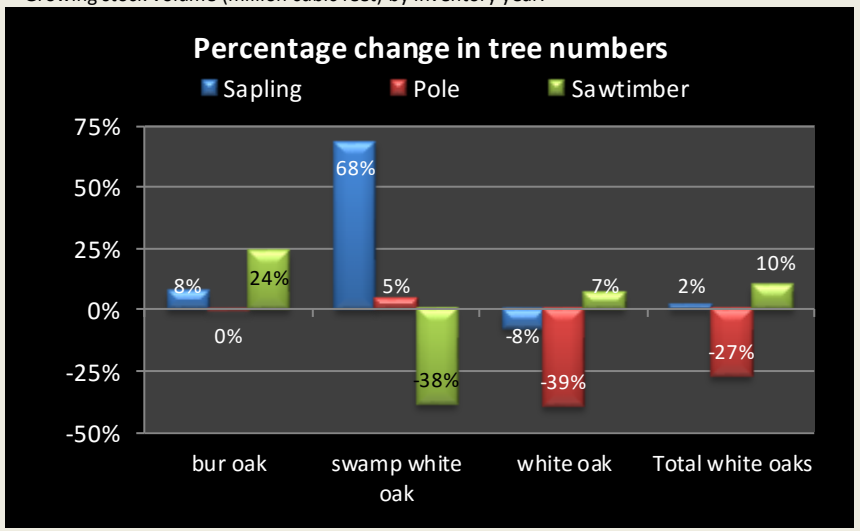
The number of poles has decreased by 27% for all white oaks and 39% for white oak since 1996 (chart below right). The number of saplings and sawtimber has increased slightly.



Growing stock volume (million cubic feet) by inventory year.



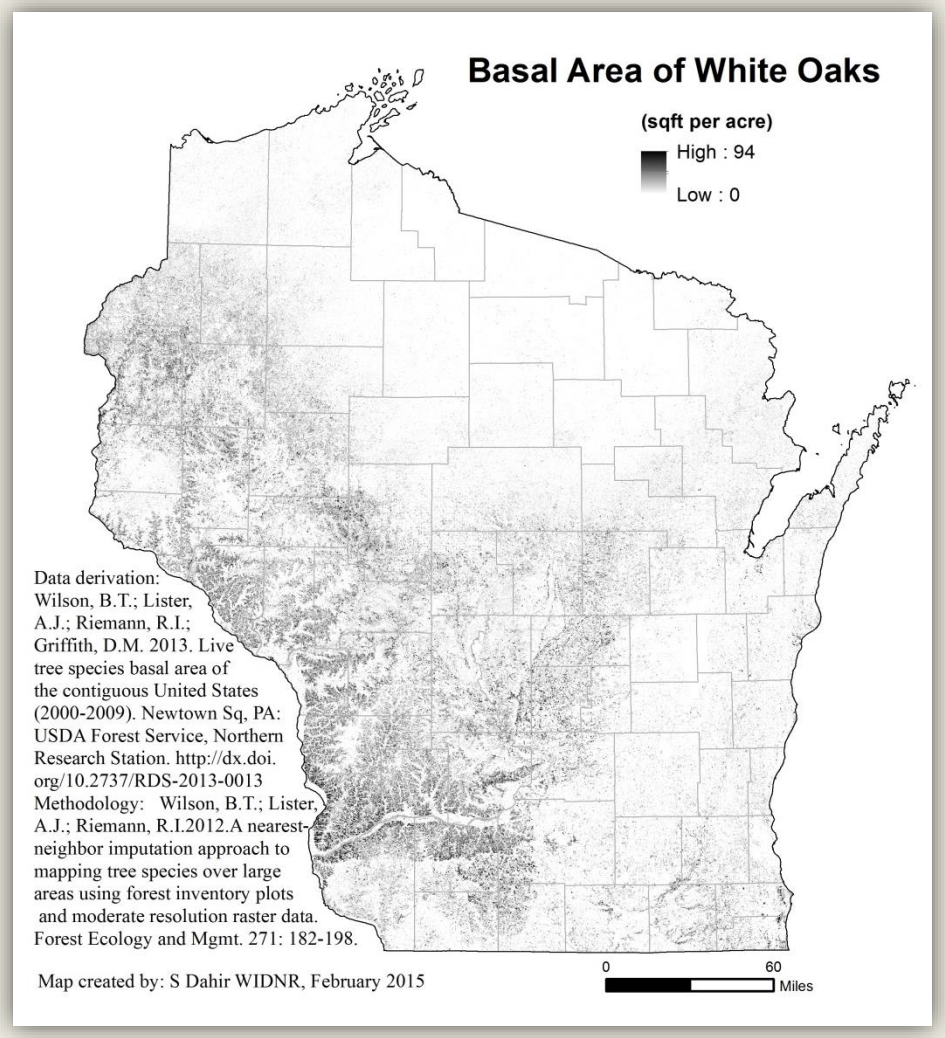
Growing stock volume (million cubic feet) by diameter class (inches).
Source: USDA Forest Inventory and Analysis data



Percentage change in the number of live trees by size class between 1996 and 2015.
Source: USDA Forest Inventory and Analysis data 1996 and 2015.

"Where do white oaks grow in Wisconsin?"

Growing stock volume by region with map



Two thirds of the white oak group is white oak with bur oak making up most of the remainder (Table 1).

White oaks occur throughout Wisconsin but are much more common in the western and central parts of the state. The northeast has only 3% of all white oak volume. The majority of white oak occurs on the oak hickory forest type.

Table 1. Growing stock volume (million cft) by species and region of the state.

Species	Central	North east	North west	South east	South west	Total	Percent of total
Bur oak	61	8	82	79	92	322	**31%**
Swamp white oak	11	3	1	11	7	33	**3%**
White oak	234	11	86	114	238	684	**66%**
Total white oaks	**306**	**22**	**169**	**204**	**341**	**1,042**	**100%**
Percent of total	**29%**	**2%**	**16%**	**20%**	**33%**	**100%**	

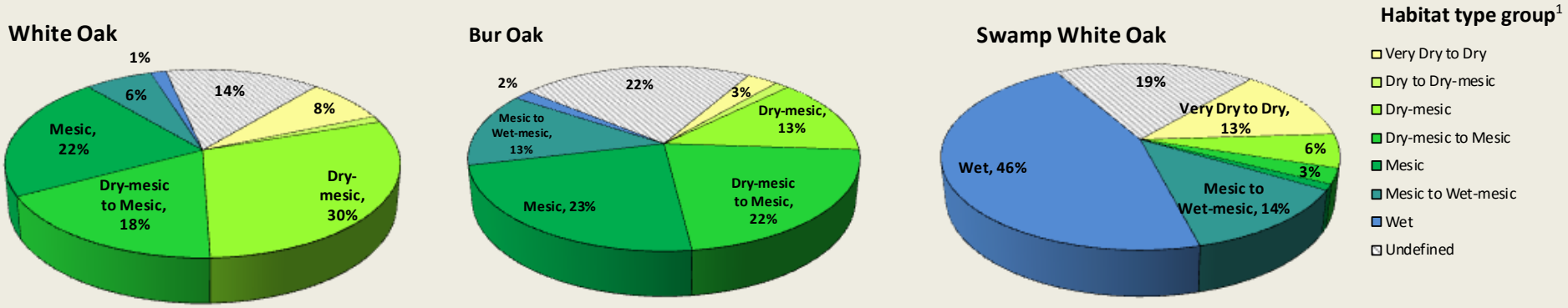
Source: USDA Forest Service, Forest Inventory and Analysis

For a table of **Volume by County** go to:
http://dnr.wi.gov/topic/ForestBusinesses/documents/tables/VolumeCountySpecies.pdf

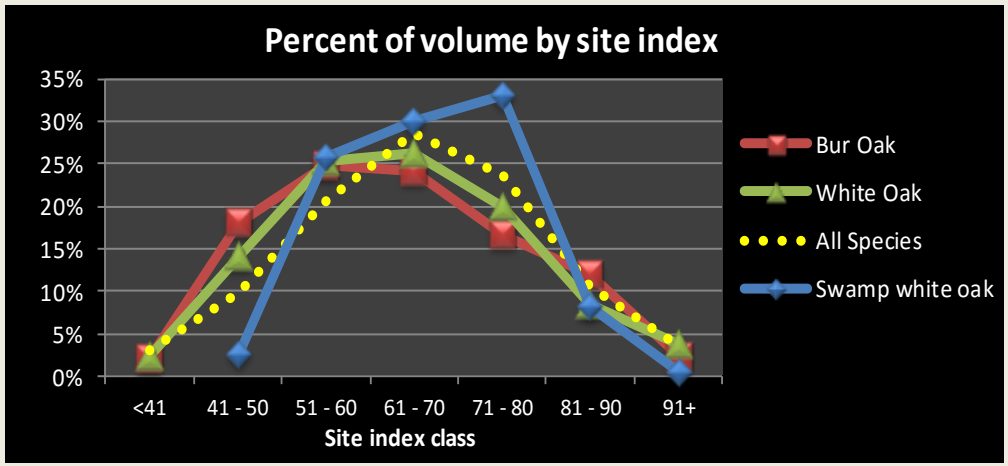
"What kind of sites does white oak grow on?"

Habitat type[1] and site index distribution

The three white oak species have different habitat preferences (chart below). Almost 40% of white oak volume occurs on dry habitat types. About 60% of swamp white oak volume is found on wetter habitat types. Bur oak occurs on a broad range of sites.



Percent distribution of growing stock volume by habitat type group (USDA Forest Inventory & Analysis data).



Percent distribution of growing stock volume by site index class (USDA Forest Inventory & Analysis data).

The majority of white oak and bur oak growing stock volume is found in stands with slightly poorer site indices (chart on left). Swamp white oak occurs on sites with a slightly higher average site index (sampling error is quite high).

The average site index by volume for white oak and bur oak is about 64, slightly lower than the average for all species, 66. The average index for swamp white oak is 68 slightly higher than the average for all species.

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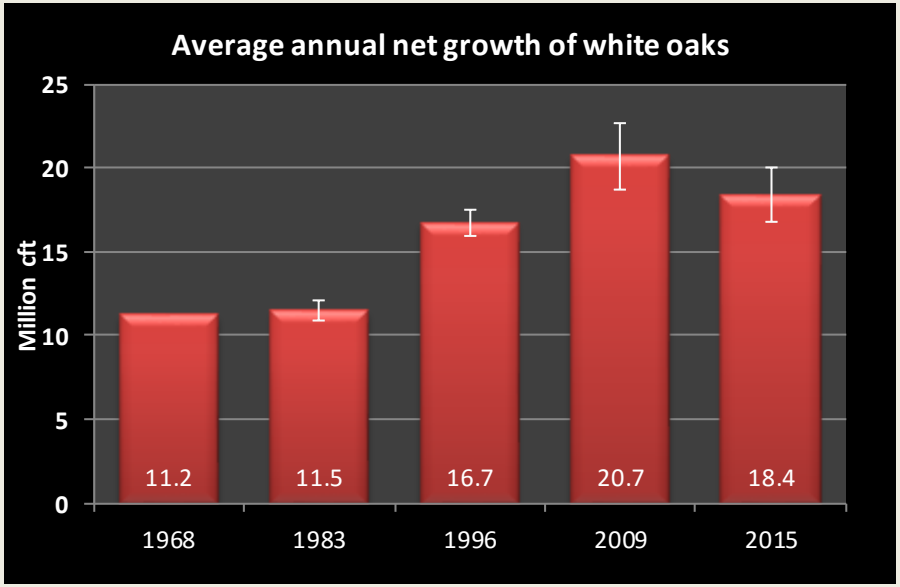
[1] For more information on habitat types see Schmidt, Thomas L. 1997. Wisconsin forest statistics, 1996. Resource Bulletin NC-183. St. Paul, MN: U.S. Dept. of Agriculture, Forest Service, North Central

"How fast are white oaks growing?"

Average annual net growth by region and year

Average annual net growth of white oaks was about 18.4 million cubic feet per year between 2010 and 2015, representing 3.2% of statewide volume growth (chart on right). Growth rates have increased 60% since 1983 but have remained unchanged since 2009.



Average annual net growth (million cubic feet).
Source: USDA Forest Inventory & Analysis data

Table 2. Average annual net growth (million cft/year) of growing stock and the ratio of growth to volume by region of the state.

Region	Net growth	Percent of total	Ratio of growth to volume
Northeast	0.4	2%	**1.8%**
Northwest	3.4	19%	**2.0%**
Central	6.4	35%	**2.1%**
Southwest	4.6	25%	**1.3%**
Southeast	3.6	20%	**1.8%**
Statewide	18.4	**100%**	**1.8%**

Source: USDA Forest Inventory and Analysis

The greatest volume of white oak growth is in southern and central Wisconsin. The average ratio of growth to volume for white oaks is 1.8%, much lower than the statewide average of 2.7% for all species (Table 2). White oaks represent 4.8% of volume but only 3.2% of volume growth in the state.

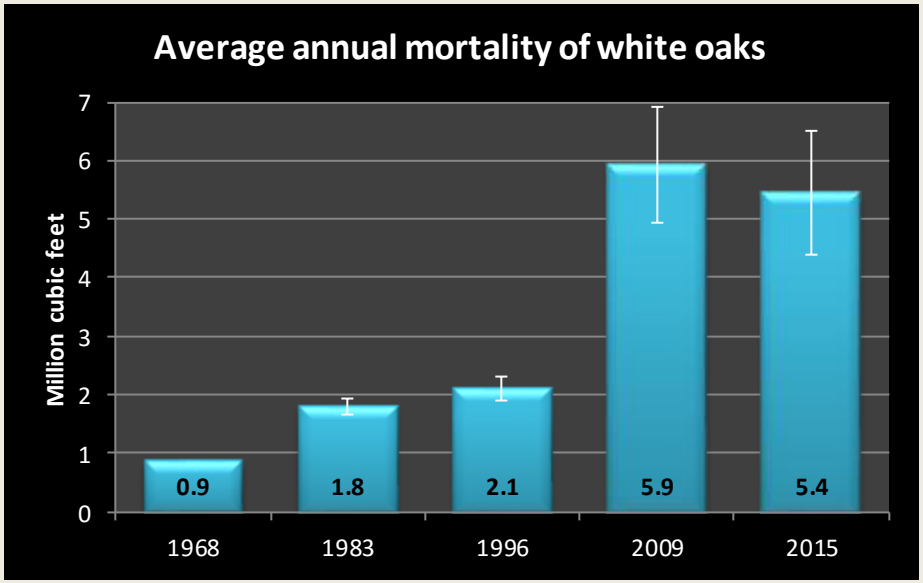
For a table of **Average annual growth, mortality and removals by region** go to:
http://dnr.wi.gov/topic/ForestBusinesses/documents/tables/GrowthMortalityRemovals.pdf

"How healthy are white oaks in Wisconsin?"

Average annual mortality by year and the ratio of mortality to volume

Average annual mortality of white oaks, about 5.4 million cubic feet per year from 2010 to 2015, has almost tripled since 1996 (chart on right). White oaks account for 4.8% of total volume in the state but only 2.3% of mortality.

The ratio of mortality to volume is 0.5% for white oaks, much lower than the statewide average of 1.1% for all species (Table 3).



Average annual mortality (million cubic feet) by inventory year.
Source: USDA Forest Inventory & Analysis data

Table 3. Mortality, volume and the ratio of mortality to volume.

Species	Average annual mortality (cft)	Growing stock volume (cft)	Mortality / volume
Bur oak	1,891,238	322,076,042	**0.6%**
Swamp white oak	121,403	33,111,325	**0.4%**
White oak	3,437,146	683,649,963	**0.5%**
Total white oaks	5,449,787	1,041,598,688	**0.5%**

Source: USDA Forest Inventory & Analysis data: 2015

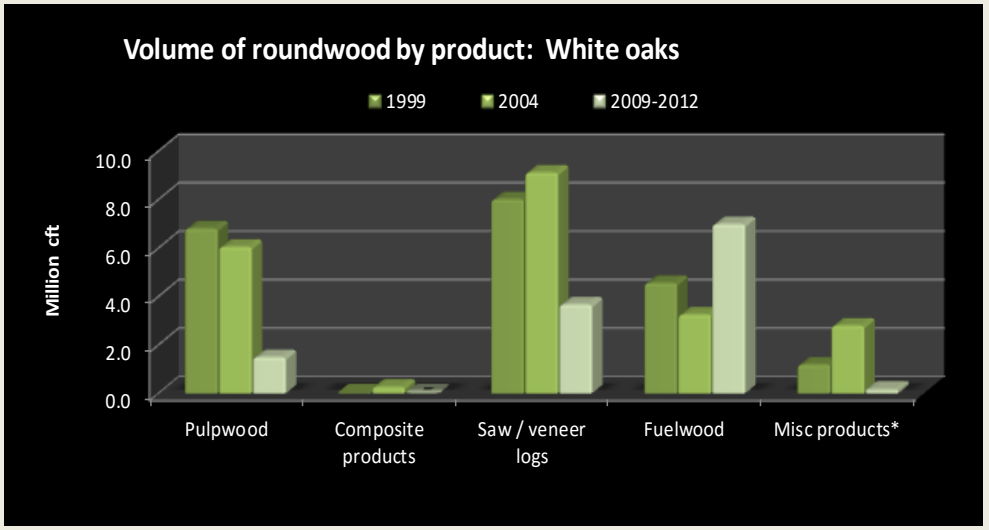
For a table of **Average annual growth, mortality and removals by region** go to:
http://dnr.wi.gov/topic/ForestBusinesses/documents/tables/GrowthMortalityRemovals.pdf

"How much white oak do we harvest?"

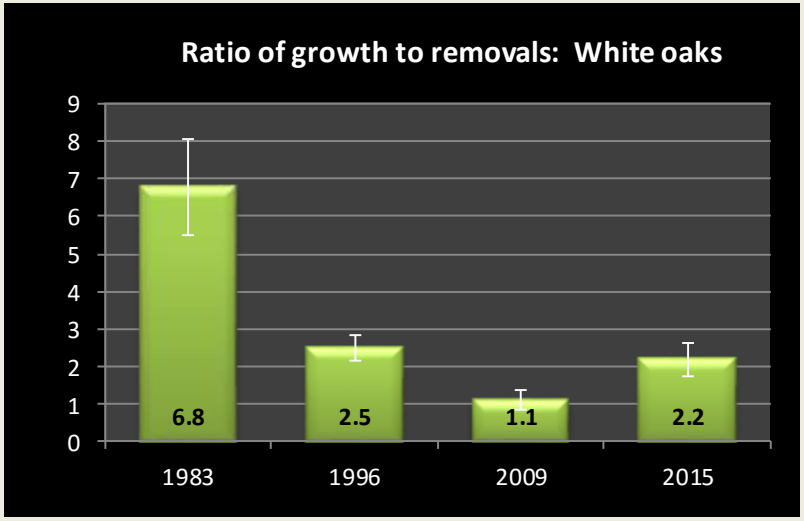
Roundwood production and removals by product and year

In 2009-2012, white oak accounted for 12.3 million cubic feet or 3.2% of Wisconsin's total roundwood, a decrease of 43% since 2004. About 60% is in fuelwood, 30% in veneer and sawlogs and 12% pulpwood (chart on right).

From 2004 to 2009-2012, pulpwood production decreased by 76% while sawlog production decreased by 60%. White oak supplies less than 1% of pulpwood but 4.8% of sawlogs.



Volume of roundwood. Most recent figures for pulpwood and composite products are from 2012 while other product volumes are from 2009. * Miscellaneous products include poles, posts and pilings.
Source: Ronald Piva, USDA Forest Service, Northern Research Station, St. Paul MN

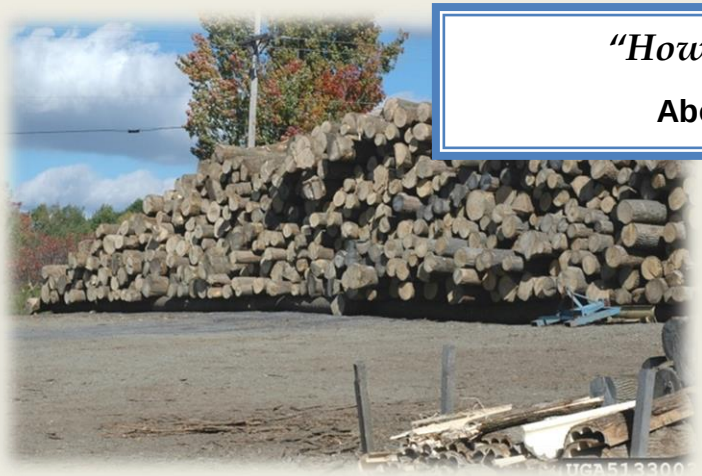


Source: USDA Forest Inventory & Analysis data

Average annual removals were 8.4 million cubic feet per year from 2010-2015 or 2.7% of statewide removals. The vast majority of this, 79%, was white oak.

The ratio of average annual net growth to removals is 2.2 for white oaks, slightly higher than the statewide average ratio of 1.7 (chart on left). Removals have fallen 37% since 2009 while growth has changed only slightly.

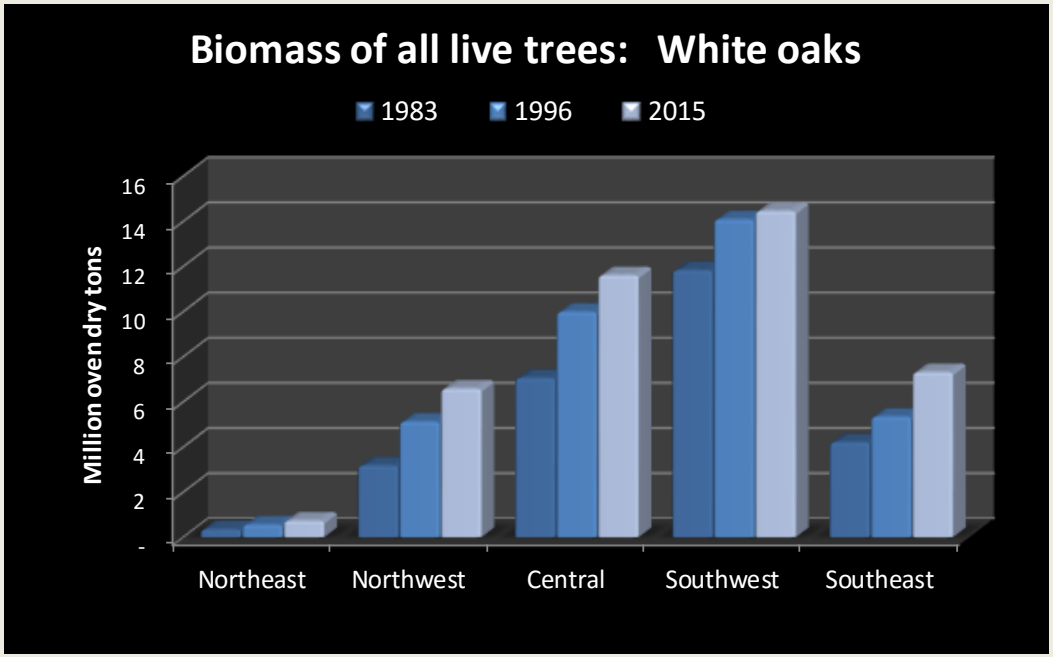
For a table of **Average annual growth, mortality and removals by region** go to:
http://dnr.wi.gov/topic/ForestBusinesses/documents/tables/GrowthMortalityRemovals.pdf



"How much white oak biomass do we have?"

Aboveground carbon by region of the state

There were 40.1 million tons of aboveground biomass in live trees of the white oak group in 2015, an increase of 50% from 1983. This is equivalent to approximately 20 million tons of carbon and represents 6.4% of all aboveground biomass statewide. As with volume, most white oak biomass is located in southwest and central Wisconsin (chart below).



Biomass (above ground dry weight of live trees >1 in dbh, short tons) by year and region of the state.
Source: USDA Forest Inventory & Analysis data

The density of white oak wood is much higher than average with a ratio of biomass to volume of 43 oven-dry lbs. per cubic foot, second only to hickory. The average for all hardwoods is about 36 ODP/cubic feet and for all species is 33 ODP/cubic feet.

Approximately, 78% of all white oak biomass is located in the main stem and 18% in the branches.

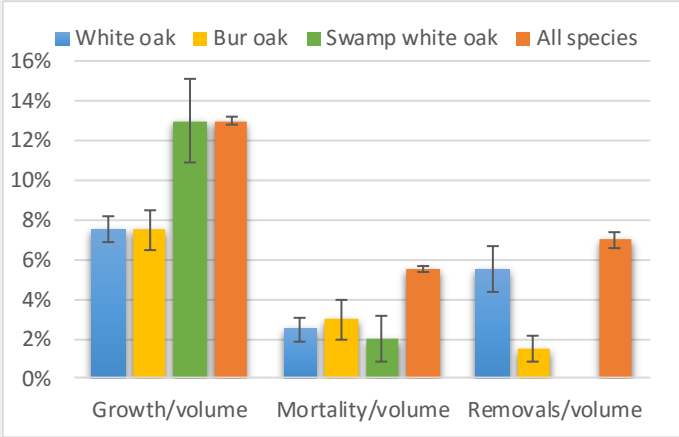
For a table of **Biomass by County** go to:
http://dnr.wi.gov/topic/ForestBusinesses/documents/tables/BiomassByCounty.pdf

"Can we predict the future of white oaks?"

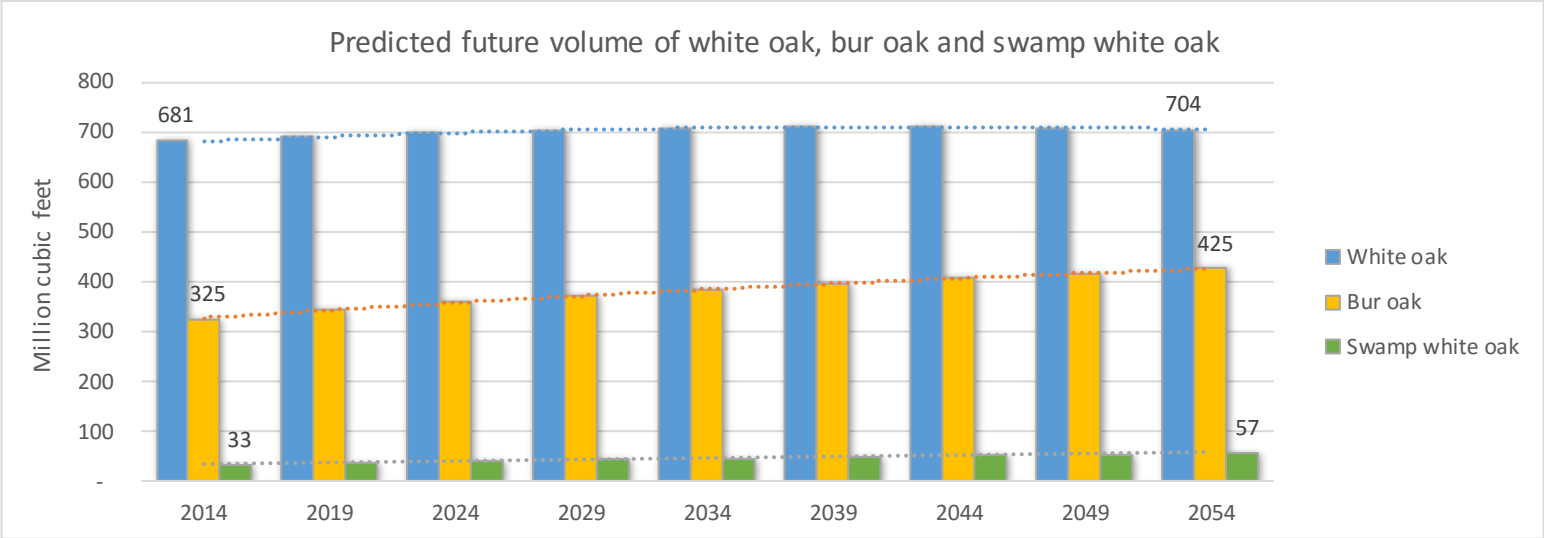
Predicted volumes based on current rates of mortality and harvest

Compared to other species, the ratios of growth, mortality and removals to volume is much lower for both bur oak and white oak (chart on right). The difference between the growth to volume ratio and the removals to volume ratio is very low is quite low for white oak indicating that volume may not increase significantly in the future.

FVS (Forest Vegetation Simulator[1]) was used to predict future volumes of white oaks through 2054 based on these rates of mortality and removals. As predicted, the volume of white oak increases only 3% and peaks in 2039. Bur oak increases 31% and swamp white oak increases 72%. Both have a much higher difference between the growth to volume ratio and the removals to volume ratio.



Ratios of growth, mortality and removals to volume of growing stock
Source: USDA Forest Inventory & Analysis



[1] The Forest Vegetation Simulator is a forest growth and yield simulation model created by the USDA Forest Service, see http://www.fs.fed.us/fmsc/fvs/.